etc. Specimens were shown illustrating the mottled effect which this texture gives to the rock under various conditions, from those of the 'lustermottled melaphyre' to those of the 'varioloid greenstone.' The origin of the mottling is partly the ready alteration of the olivine, partly the porosity between the augite crystals. This latter character may be rather characteristic of the effusives.

Occurrence of Diamonds in North America: GEORGE F. KUNZ. Read by title.

Silver-gold Ores at San Pedro de Guanacevi, Durango, Mex.: FREDERICK B. PECK. No abstract received.

Perspective View of the Submarine Canyon of the Hudson River: J. W. SPENCER. Read by title. (Read before Section E, American Association for the Advancement of Science, December 31.)

Titaniferous Basalts of the Western Mediterranean. H. S. WASHINGTON. Read by title.

The Paleozoic Section of the Upper Yukon: A. H. BROOKS and E. M. KINDLE. Read by title.

Stratigraphic Succession North of Cook Inlet, Alaska: SIDNEY PAIGE and ADOLPH KNOPP. (Introduced by A. H. Brooks.) Read by title.

Seismological Observations in the United States: H. F. REID. Read by title.

Peale's Painting of the Exhuming of the First American Mastodon: ARTHUR BIBBINS. Read by title. (Read before Section E, American Association for the Advancement of Science, December 31.)

Relations of the Ithaca and Chemung Faunas of Western Maryland: C. K. SWARTZ. Read by title.

EDMUND OTIS HOVEY.

ZOOLOGY AT THE NEW YORK MEETING

II.

The Order of Appearance of the Ambulacral Appendages in Holothuria floridana Pourtalès:[1] CHARLES L. EDWARDS.

Tentacles.—During the fourth day the embryo has a primitive symmetry of four tentacles; one placed in the mid dorsal interradius arising from the left dorsal radial canal, one in the right dorsal interradius from the right ventral radial canal, one in the right ventral interradius from the mid ventral radial canal and one in the left dorsal interradius from the left ventral radial canal. During the fifth and last day within the vitelline membrane, the embryo buds a fifth tentacle into the left ventral interradius from the mid ventral radial canal. In this condition the Holothurid hatches during the sixth day but it is not until the eighth day that the fifth tentacle has grown to the size of the four primitive tentacles. On the fortieth day a sixth tentacle develops in the right ventral interradius from the right ventral radial canal. From the forty-second to the forty-fifth days the next three tentacles appear; the seventh, in the left ventral interradius, from the left ventral radial canal, the eighth, in the mid dorsal interradius from the right dorsal radial canal and the ninth, in either the right or left dorsal interradius, from the right or left dorsal radial canal, respectively. On the fifty-third day the tenth tentacle appears in the dorsal interradius opposite to that in which the ninth has developed. On the seventy-fifth day the eleventh tentacle appears in the mid dorsal interradius.

Pedicels and Papillæ.—The first pedicel has budded from the posterior end of the

[1] Formerly identified as *Mülleria agassizii* Sel. —Edwards, C. L., 'Notes on the Embryology of *Mülleria Agassizii* Sel., a Holothurian common at Green Turtle Cay, Bahamas,' Johns Hopkins Univ. Circ., 1889, Vol. VIII., p. 37.

mid ventral radial canal on the fourth day and, after hatching on the sixth day, develops a sucker. On the ninth day a second pedicel arises to the left from the mid ventral radius. Only two pedicels are found until the twenty-second day when a third appears also to the left of the mid ventral radius. On the twenty-fourth day buds of the first pair of papillæ ventrad from the anterior ends of the dorsal radii inaugurate the bilateral symmetry later shown in the appendages. On the thirtieth day the fourth pedicel, *again to the left,* arises from the mid ventral radius and also one bud ventrad from both right and left ventral radii. Not until the fortieth day does the first pedicel arise to the right from the mid ventral radius. On the fifty-third day the second pair of papillæ arises ventrad from toward the posterior ends of the dorsal radii. At this time twenty pedicels and nineteen buds have appeared from the ventral radii and nine papillæ and twenty-seven buds from the dorsal. The seventy-fifth day in my series from the embryos presents the largest number of appendages, forty developed and forty-five buds. Four of the smallest adults from my statistical series have 77, 99, 141 and 150 appendages and twenty, the adult number, of tentacles.

Some Further Points in the Development of Ophiothrix fragilis: E. W. MacBride, M.A., F.R.S., McGill University.

In December, 1903, the author read a paper at the Philadelphia meeting of the American zoologists on the early stages in the development of the British ophiuroid, *Ophiothrix fragilis.* Since that time he has been continuously engaged in working out the development completely and hopes to be able to publish an exhaustive account of it this summer. Meanwhile some interesting points have transpired. In the former paper on the subject the segmentation was described as leading to the formation of a morula. An invagination on one side gave origin to the archenteron, the invaginated cells not forming a simple vesicle but a sac with a solid tongue projecting from one side of it. From the apex of the archenteron the cœlom arose as a vesicle, and the embryo became triangular in shape—one point being posterior and the two others the rudiments of the first arms of the ophiopluteus larva. The interior cells of the morula gave rise to the mesenchyme from which the skeleton of these arms was developed. A subsequent visit to Plymouth and renewed experiments in artificial fertilization led to the unexpected result that the type of development previously described was that of eggs which were not quite ripe. When a male and female were enclosed in a glass jar and allowed to spawn naturally the segmentation of the egg led to the formation of a hollow blastula one side of which became thickened and gave rise to mesenchyme. Regular invagination followed giving rise to a normal archenteron entirely devoid of any such tongue as was described above, the cœlom arose as a thin-walled vesicle which became completely separated from the archenteron before dividing into right and left halves. At the opposite pole of the larva to the blastopore there was developed a great crest of vacuolated cells, probably an apparatus to assist in flotation. This crest disappeared as the first two arms of the larva became larger. It follows, then, that it is not a certain test of the ripeness of an egg that it can be fertilized, and that a small change in the chemical condition of the egg can effect a great change in the subsequent development.

The later development of the larva is interesting on account of the history of the cœlom. This becomes divided on both left and right sides into anterior and posterior

halves. Then later from the posterior end of the anterior half on each side a vesicle grows out. These vesicles are the left and right hydrocœles. The latter though rudimentary in the adult is at first just as large as the left one which gives rise to the water-vascular system. The right hydrocœle in Asteroidea and Echinoidea has from the first a position near the mid dorsal line, on which account some have doubted its homology with the left hydrocœle. But there can be no doubt of its homology in *Ophiothrix fragilis* where it is not only normal in position but sometimes assumes a five-lobed form similar to that of the left hydrocœle. Its dorsal position near the primary water-pore in Asteroidea and Echinoidea is accounted for by the fact that in these groups it is oriented not with respect to the larval mouth but with respect to the permanent mouth which is on the left of the larva. In Ophiuroidea, where the larval mouth persists as the adult mouth, it is accordingly found unmistakably on the right side. Subsequently the preponderant growth of the left hydrocœle and all the structures associated with it carries the water pore dorsal to the mouth over to the right side where it comes to lie near the right hydrocœle, a position which it occupies from the beginning in Asteroidea and Echinoidea.

Exhibition of Embryos of the Japanese Frilled Shark, Chlamydoselachus anguineus, with Comments upon its Plan of Development: BASHFORD DEAN, Columbia University.

Mercator Projections of Vertebrate and Arthropod Embryos: WILLIAM PATTEN, Dartmouth College.

The Pre-placental Development in Geomys bursarius: THOMAS G. LEE, University of Minnesota.

This investigation is a continuation of the writer's comparative studies upon the earliest stages of development in North American Rodentia.

Geomys bursarius, or the 'pocket gopher' as it is commonly called, is characterized by the so-called inversion of the layers which is of a much simpler type than that found in other rodents, as the mouse and guinea-pig.

Development takes place entirely outside of the uterine cavity in a decidual cavity formed by the vascularization and breaking down of the ventral uterine connective tissue. The didermic blastocyst perforates the epithelium lining the ventral portion of the uterine cavity. This perforation is relatively large and does not become closed as in the guinea-pig or in man, but remains open for a considerable period. The epithelial lip of this rounded opening becomes somewhat thickened and everted.

The trophoblast, in a zone a little way external to the germinal area, becomes adherent to the outer margins of this epithelial lip, thus suspending the blastocyst while the decidual cavity is being hollowed out beneath it in the connective tissue.

Rauber's layer disappears from the surface of the germinal area at about the time of perforation. The entoderm forms a well-marked vesicle or yolk-sac which rapidly increases in size and which becomes invaginated on its dorsal surface by the sinking in of the germinal area, thus bringing about the so-called inversion of layers.

The amnion is formed by the folding over and fusion of the outer margins of the germinal area from all sides, while the outer portion of these folds, composed of trophoblast, form a membrane constituting the serosa or false amnion. This serosa now closes the opening through the uterine epithelium above referred to.

At a later period, secondary folds of the serosa appear which unite forming a two-layered cup or vesicle of trophoblastic

tissue, the cavity of which disappears by the proliferation of the cells, and this rounded plate of trophoblast which now constitutes the fœtal portion of the true placenta is brought into contact with the epithelium of the dorsal portion of the uterine cavity, giving rise to the true placenta.

Into the ventral surface of this trophoblastic plate extends the vascular mesoderm to complete the allantoic portion of the placenta.

While these changes are taking place, the embryo has been rapidly developing, nourished by a highly developed yolk-sac placenta which ceases to be functional after the completion of the true dorsal placenta.

The Maturation of the Mouse Egg: W. R. Coe and W. B. Kirkham.

The process of maturation and fertilization in a mammalian egg was first described in detail by Sobotta in 1895. His work was with the mouse egg, and he recorded the formation of more than one polar body in only one tenth of these eggs. Gerlach, after a study of preparations made as early as 1890, has recently revived Tafani's theory that in the majority of mouse eggs the second polar body is suppressed. Gerlach's conclusion is that when a spermatozoon enters an egg some time after it has formed the second polar spindle, the second polar body fails to develop, the spindle degenerating within the egg. These observations differ not only from almost all those previously made upon other eggs, but also from the conclusions since arrived at by Van der Stricht, Heape and Rubaschkin, for the eggs of the bat, rabbit and guinea-pig, respectively, who all agree that two polar bodies are regularly formed by every ripe egg.

Careful study of numerous series of sections of eggs and ovaries of the white mouse have led to the following conclusions:

1. Two polar bodies are apparently formed by every egg which is capable of development, the first polar body appearing within the ovary, the second after the entrance of the spermatozoon into the egg.

2. At the end of the spireme the number of chromatin masses is between twelve and twenty-four.

3. Twelve masses of chromatin are cast out with the first polar body, and a like number remain in the egg.

4. There is a sharp distinction in form between the chromosomes of the first and those of the second polar spindle.

5. Every egg which we have seen in the Fallopian tube before fertilization possessed a second polar spindle.

6. The zona pellucida, which is quite distinct, may persist undiminished through the early cleavage stages; but in most cases the first polar body escapes from it during the process of ovulation, so that the majority of eggs after fertilization possess the second polar body only.

7. During the spring months ovulation commonly occurs every twenty-one days, independent of copulation.

8. The number of univalent chromosomes in the second polar spindle is twenty-four, of which the second polar body receives twelve, leaving an equal number to form the egg nucleus.

9. The second polar body is formed only after the egg has been fertilized.

10. The first and second polar bodies differ in size, shape, and especially in chromatin content, so that they are easily distinguishable.

11. At least the greater part, if not the entire sperm tail enters the egg at the time of fertilization.

12. Since the mouse egg in every case which we have observed forms two polar

bodies of typical constitution, its maturation processes are in accord with those of most other metazoon eggs.

The 'Accessory Chromosome' in Anasa tristis: KATHARINE FOOT and E. C. STROBELL, New York.

The authors interpreted the so-called chromosome nucleolus of the resting spermatocyte as the homologue of the nucleolus of the egg and not as a chromosome, as maintained by the cytologists who have previously investigated this form. They interpreted the so-called heterotropic chromosome as a bivalent, representing in value two spermatogonial chromosomes and not one. In a series of forty-nine photomicrographs they traced it from the early prophase to the telophase of the second division, demonstrating its division both in the first *and in the second* spindle. Three of the photomicrographs showed spermatogonia in which twenty-two chromosomes were demonstrated.

Secondary Chromosome-couplings in Hemiptera and their possible Significance: EDMUND B. WILSON, Columbia University.

As secondary chromosome-couplings we may designate unions or associations of the chromosomes that take place independently of synapsis, such as those described by Sinéty in *Leptynia* and by McClung in the Acrididæ. In the spermatogenesis of the *Hemiptera heteroptera* such couplings occur in several genera. In *Pachylis gigas* the 'accessory' or odd chromosome often couples with one member of one of the bivalents in the first spermatocyte-division and passes with it to one pole, but the process is inconstant and appears to be of a casual character. In *Thyanta custator,* on the other hand, there is a small unpaired chromosome that is always separate from the others in the first division but in the second is invariably coupled with one member of the smallest pair of chromosomes and passes with it undivided to one pole. *Metapodius* presents a still more interesting relation. Here a small unpaired chromosome is present in some individuals, but not in all, in addition to a pair of typical unequal idiochromosomes. The latter show the usual relation to sex-production, while the unpaired chromosome may be present in either sex and hence is of different nature from the odd or 'accessory' sex-chromosome. Here too the unpaired chromosome is always separate from the others in the first division, but in the second it is in about 80 per cent. of the cells coupled with one of the idiochromosomes. In a marked majority of cases the coupling takes place with the small idiochromosome, and the unpaired chromosome passes to the male-producing pole; but in some cases the coupling is with the large idiochromosome. We should, therefore, expect to find the unpaired chromosome present in a majority of the male individuals and in a minority of the female ones; and this is borne out by the data as far as they go, though they are somewhat scanty. Of seven males (testes) five possess and two lack this chromosome. Of five females (ovarian cells) but one possesses while five lack this chromosome. The conditions are constant in each individual.

These facts suggest that if the chromosomes embody the primary factors of heredity, the coupling of chromosomes may give the physical basis of certain forms of character-couplings. For instance, the coupling of the sex-characters with the somatic species-characters observed in certain forms of Mendelian hybrids in Lepidoptera may be due to a coupling of the sex-chromosome with one of the other chromosomes, of the same general nature as that observed in *Metapodius.* The study of the chromosomes in such cases in

combination with experimental work may thus give a decisive test of the general chromosome-theory of heredity.

Maturation Processes in Paramecium caudatum: Gary N. Calkins, Columbia University.

On the Formation of Regenerative Masses in Sponges allowed to degenerate in confinement: H. V. Wilson, University of North Carolina.

Silicious sponges (*Stylotella, Microciona*) kept under favorable conditions in aquaria undergo degenerative changes, resulting in the formation of small masses of unspecialized tissue, which lie scattered through the dead sponge, like gemmules in a *Spongilla*. Such masses when returned to the normal environment transform into perfect sponges.

The Influence of a Strong Centrifugal Force on the Egg of Arbacia: T. H. Morgan and E. P. Lyon.

The Influences of External Factors, Chemical and Physical, on the Development of Fundulus Heteroclitus: Charles R. Stockard, Columbia University.

1. *Fundulus* eggs develop normally, although at a somewhat faster rate, when kept on moist plates entirely out of water. Such embryos are unable to hatch while on the moist plates, but if at any time after the control has begun hatching some of the eggs are immersed in sea-water they will soon begin hatching, commencing usually in about ten minutes after being in the water and all coming out promptly. On hatching the embryos show a positively heliotropic and a negatively geotropic reaction.

Embryos were kept thirty-three days, or twenty days after the control had begun hatching, on these moist plates without beginning to hatch. The fish within the egg membrane grows in length and absorbs its yolk at about the same rate as hatched ones do. They finally die of starvation after having assimilated all of their yolk, being still confined within the egg membrane.

2. These eggs are not entirely immune to osmotic effects though it has often been stated that they are. In weak cane sugar solutions the yolks were observed to swell; this has not been seen even in eggs developing in distilled water, and may probably be due to some change taking place in the sugar after it has permeated the egg membrane. In concentrated sugar solutions the yolk shrinks in a somewhat definite manner. A 1.53 m distilled water solution of cane sugar killed the eggs within twenty-three hours. The osmotic pressure of such a solution is about 34.278 atmospheres, about twelve atmospheres more than that of sea-water. Some salt solutions exerting even a greater pressure do not kill the eggs. The contradiction is possibly due to the cane sugar becoming inverted in the solutions and its pressure is thus more than the amount calculated. On comparing the effects of sea-water solutions of sugar with distilled water solutions it was found that a pressure more than double as high in sea-water produced a much less marked effect. Sea-water solutions were alkaline and inversion of the sugar was not so likely to occur.

3. Several lithium salts produced similar and characteristic abnormalities in development.

4. Embryos developed in solutions of KCl show no heart beat or circulation of the blood; the circulatory system is also abnormal. NH_4Cl produces a general and indefinite effect on development. $MnCl_2$ causes a definite effect on the early stages of development. $MgCl_2$ causes the formation of cyclopean monsters. NaCl causes the embryos to swim abnormally in a twisting spiral course.

5. Mixed solutions of salts and sugar act more intensely on the *Fundulus* egg than either constituent would if used alone. A small dose of a salt will give the effect of a much stronger dose if sugar be added to the solution.

The Degree of Correlation of Certain Internal Characters in the Toad: W. E. KELLICOTT, Womans College, Baltimore.

Morphogenetic Localization in Aglaophenia: RAYMOND PEARL, University of Pennsylvania.

In the plumularian hydroid *Aglaophenia helleri* each fully grown internode of the hydrocladium is divided into three regions by two incomplete, transverse, chitinous septa or ridges. The proximal one of these ridges is at the level of the intrathecal ridge, and the distal one is at the level of the proximal border of the supracalycine nematophores. A study was made of the proportionality of the parts of the internode marked out by these ridges. The general results may be stated as follows: (1) Those proportions of the individual internode and hydrotheca (= person) which involve the localization of points by a process of differentiation *in situ* after growth is entirely or nearly completed, are maintained in different persons with very much less constancy or precision than are those proportions which depend primarily on growth (as distinct from differentiation) localizations. (2) There is a distinct correlation between the proportionality of the parts and the absolute size of the person in *Aglaophenia*. In this as in all other cases which have so far been studied quantitatively with reference to this point, the actual facts are in direct contradiction to the fundamental assumption made by Driesch in the development of his so-called 'first proof of the autonomy of vital phenomena,' to the effect that the proportionality of the parts of an organism is something quite independent of the absolute size.

Correlation as the Basis for Selection in Lepidoptera: H. E. CRAMPTON, Columbia University.

The Blending and Overlap of Instincts: FRANCIS H. HERRICK, Western Reserve University.

There are many anomalous actions or peculiarities of behavior in wild birds which have not been satisfactorily explained, although certain of them have been long known. Some of the eccentricities of conduct referred to are the following: (1) Repair of the old nest or the building of a new one at the close of the breeding season; (2) omission of nest building, and dropping of eggs on the ground; (3) leaving young to perish in nest, and starting on migration; (4) offering strings or other objects to young in the place of food; (5) building more than one nest including the 'cock nests' of marsh wrens; (6) rebuilding on the same 'site,' producing superimposed nests or nests of from two to four 'stories' 'to conceal' foreign bodies, such as the cowbirds' eggs in the nests of vireos and warblers.

All of these curious actions receive much light, and in most cases are satisfactorily explained by what we shall call the blending or overlapping of instincts. As shown in another paper, the wild bird commonly passes through a cycle of instincts which mark the breeding season. This cycle is made up of eight or more terms, which follow in serial order, and some of which are recurrent. Normally the bird passes from center of influence 1 to center 2, 3, and so on, to the end of the cycle. There is little overlap or blending, the bird remaining under the influence of a given instinct or series of instincts, such as nest building, incubation, or feeding the young until its instinct in any given direction has

been satisfied, before entering a new sphere or being swayed by new impulses. When the correlation or attunement is perfect the instincts of mother and child fit like lock and key. To change the figure, like clocks beating synchronously the instincts of parent and child are generally in harmony, but one of the clocks occasionally gains or loses, stops or runs down; one term is liable to be weak or to drop out altogether, so that there is an overlap or a gap in the series which may be serious. On the other hand, one term may be unduly strengthened, like nest building or incubation, and a preceding or following term correspondingly weak. In all such cases there are eccentricities of conduct, which, if not fatal to the young, are very puzzling to the naturalist.

Most wild birds normally pass one reproductive cycle in the season; a certain number, however, begin, but do not complete a second cycle; further, many like the robin and bluebird not only begin but complete a second and even a third cycle within the breeding period.

The repair of the old nest in autumn by fish hawks or eagles is not done 'in anticipation of spring,' and implies no more intelligence than the building of the original nest. It is simply the recrudescence of the building instinct, due to the beginning of a new reproductive cycle which is never finished.

Leaving the young to perish in the nest in autumn is brought about by the scamping of the cycle at the other end. The migratory impulse overlaps and replaces the parental instinct.

An adult robin has been seen to offer a string to its fully grown young, and try to cram it down the throat of the fledgling. Later, the old bird flew with the string into a tree. This was the result of the overlapping of two reproductive cycles, or of the last term of one cycle, and the first term of a succeeding cycle. The bird was alternately swayed by opposing impulses, now being impelled to gather nesting material, when she picked up the string, now by parental instinct to feed her young, when she tried to serve it, and again possibly by the instinct of building when she flew with the string into a tree.

Building more than one nest can be accounted for by excessive development of the building instinct, or by the influence of fear repeatedly interrupting the cycle, together with attachment to nesting site, but the discussion is too long for this abstract.

The rebuilding of nest on nest, giving rise to the wonderful storied structures sometimes produced by the summer yellow bird, or vireo, when plagued by the cowbird, so that the foreign egg is buried out of sight, is not an illustration of reason, as commonly believed, but the curious result of a pure instinct. The reproductive cycle is broken by fear, and a new one is begun, and in these rare cases the old nest is retained as a *site to be built upon.* Instead of having two *supernumerary* nests, both of which may contain eggs, as in reported cases of the phœbe, we have a series of *superimposed* nests. The new nest is not built to *conceal* the cowbird's egg, although it does this perfectly, any more than the addition of new materials to the osprey's nest in the fall is in the nature of repairs, although it answers this purpose admirably. The nest is built because the bird is at the opening of a new cycle, and is impelled by the building instinct.

Many confirmatory facts could be given. The herring gull will not only bury an egg, in rebuilding on its old site, in this case the discarded nest, when its cycle has been interrupted by fear, but will bury its dead young which it treats as so much nesting material.

Notes on the Behavior of Sea-Anemones: CHAS. W. HARGITT.

The paper discussed the aspects of behavior of several species of sea-anemones studied both under natural conditions and those of the laboratory. The points chiefly under observation had reference to the behavior of these creatures under the influence of light. So far as known few details along this line have been recorded.

At least three species of anemones were found which showed very evident reactions to photic stimuli, namely, *Eloactis* (*Halcampa*) *producta*, *Sagartia modesta* and *S. leucolena*. Of these two are tube-dwelling, burrowing in the sand near tide lines, and forming rude tubes or burrows through the adhesive secretions of the ectoderm. *S. leucolena* is occasionally found in similar habitat, though chiefly adhering to rocks or among colonies of ascidians, or sponges, on piles of docks, etc. Experiments showed that the first two species are most sharply responsive to light, and this sensory sense is located chiefly in the tentacles and oral regions of the body. *S. leucolena*, while less sensitive, is yet evidently so in strong light. Exposed to direct sunlight it quickly closes up into a hemispherical mass, or creeps over the edge of the rock or shell into shaded portions, of the aquarium. In its native haunts it may be found protruding its crown of tentacles from a crevice while the body is hidden.

Sagartia luciæ is a free-living species found abundantly almost everywhere, on rocks in open pools, or on floating fucus, and freely exposed to direct sunlight, action of waves, etc. Of similar habit is *Metridium marginatum*. Neither of these species seems in the least degree responsive to photic stimuli. Under a strong beam of sunlight reflected directly upon them for ten minutes they showed no response whatever.

These facts, together with others as to food-habits, etc., render it quite certain that their behavior is due to several factors, and that in response to light there is an evidence of adaptation involving varying physiological conditions, of which the burrowing habit is one of several expressions.

The Simulation of Death by Fishes: ULRIC DAHLGREN, Princeton University.

Spawning Behavior and Sexual Dimorphism in Fundulus heteroclitus and Allied Fish: H. H. NEWMAN, University of Michigan.

Some Points in the Development of the Florida Alligator: ALBERT M. REESE, Syracuse University.

External Morphology of the Head of Limulus: WILLIAM PATTEN, Dartmouth College.

The Function of the Gastrolith of the Lobster: L. W. WILLIAMS, Harvard Medical School.

The gastrolith appears for the first time in the fourth stage lobster at or before the middle of the period between the molts and, after the molt, there proceeds, *pari passu* with the dissolution of the gastrolith, a hardening of the gastric teeth, the mandibles, and the chelipeds. Soon after the absorption of the gastrolith the newly molted lobster attacks and eats the greater portion of its cast. Reasoning from these facts, we suggest that the lime in the gastroliths is reserved for the rapid hardening of the teeth, mandibles and chelipeds so that the relatively vast supply of lime in the slough and in other shells may be made available, at once, for the hardening of the new shell.

This paper is to appear in the Report of the Rhode Island Commission of Inland Fisheries, now going to press.

The Artificial Production of a Single Median Eye in the Fish Embryo by Means

of Sea-water Solutions of Magnesium Chlorid: Charles R. Stockard, Columbia University.

Fundulus embryos when developed in certain strength solutions of $MgCl_2$ in sea-water form a large single median eye. This condition is comparable to the one eyed human monsters known as *Cyclops, Cyclopia* or *Synophthalmia.*

The single eye results from an antero-medio-ventral fusion of the elements of the two optic vesicles at an early developmental stage. This fusion is more or less complete in the different embryos.

The large compound optic cup induces the formation of a single lens. This lens is formed from ectoderm different in position from that of the normal lens-forming region. The lens is abnormally large in size as is also the optic cup, and the size of the former varies directly with that of the latter. It is probable that there is no localization of lens-forming substance in the ectoderm of the fish embryo. This inter-relationship in the development of the optic cup and lens is interestingly compared with the processes of development in the amphibian eye as shown by recent experiments.

Mixed sea-water solutions of $MgCl_2$ and NaCl also cause the one-eyed condition. Since such a defect is characteristic of the $MgCl_2$ action when used in sea-water solutions one must infer that the Mg constituent in the mixture is responsible for the result.

Method of Making Series of Anatomical Drawings: G. A. Drew, University of Maine.

The Influence of Direction vs. Intensity of Light in Determining the Phototropic Responses of Organisms: Leon J. Cole, Kingston, R. I.

The large land planarian, *Bipalium kewense,* was the principal animal experimented with. Its responses were first tried to shadows from a light directly overhead, *i. e.,* non-directive. It was then tested in a *partial* shadow, a strip of less intense light in an area of more intense illumination. In this case all the light came from one direction, namely, horizontally, from one side. Although strongly negative, the worms would crawl directly *toward* the light in the partial shadow rather than turn out into the greater intensity. A similar result was obtained with the earthworm (*Allolobophora fœtida*). In these experiments *Bipalium* and *Allolobophora* appeared to respond to *intensity* alone, regardless of the direction of the impinging light.

Chromatin Changes in Hydroids: W. M. Smallwood, Syracuse University.

The Sexual Phase of the Life Cycle in Amœba: M. M. Metcalf, Oberlin College.

The Existence of an Organ of Equilibration in Certain of the Lower Crustacea: C. O. Esterly, Harvard University. (Introduced by E. L. Mark.)

The Habits and Life History of Cryptobranchus allegheniensis: Bertram G. Smith. (Introduced by Dr. O. C. Glaser.)

The adult *Cryptobranchus* has its dwelling place in a cavity or cavern under a large rock, in swift and shallow water. The animal seldom comes out during the daytime, except during the breeding season. The eggs are laid and fertilized during the first two weeks in September. They are deposited in the usual dwelling-place of the animal. About 450 eggs are laid by a single female. Fertilization is external as in fishes; no spermatophores are formed. After the eggs are deposited they are usually guarded for a time by the male, who fights and drives away other hell-

benders which attempt to eat the eggs. The male himself eats some of the eggs, but on account of the slowness of his digestion is unable to eat more than a small proportion, hence his presence is in the main protective. In defending the eggs the male is merely guarding his own food-supply; the origin of the brooding habit in this case seems to be the feeding habit. The eggs hatch about six weeks after fertilization. The newly hatched larva is about 25 mm. long, and has a large yolk sac. Larvæ kept in the laboratory for two months after hatching retain a remnant of the yolk sac, and refuse food. Year-old larvæ are 6–7 cm. long, and retain the external gills. Larvæ two years old are about 12 cm. long and the external gills are greatly reduced. Sexual maturity is attained with a length of about 34 cm. and probably requires three or four years.

Relations between Regeneration, the Degree of Injury, and Moulting in Young Lobsters: V. E. EMMEL, Brown University.

The phenomena of regeneration and moulting in the lobster present two distinct processes of cellular activities. The one, moulting, is going on more or less continuously throughout the period, or cycle, between moults: the other, regeneration, may be artificially induced at various points within this cycle. The problem is: what influence do these two processes exert upon each other?

A series of experiments were made on fourth stage lobsters to determine—first, the influence of regeneration upon the duration of the moulting cycle, or period between moults; second, the rate of regeneration at different stages of the moulting cycle; and third, the effect of different degrees of injury upon moulting and regeneration. The results obtained seemed clearly to demonstrate the following points:

1. That the effect of regeneration is to retard the process of moulting; and that this effect varies according to the time of mutilation, so that the later the process of regeneration is induced in the moulting cycle, the greater is the duration of the period between moults.

2. That, on the other hand, the rate of regeneration varies also according to the time of mutilation, so that the later the mutilation is made in the cycle, the more rapid is the rate of the ensuing regeneration.

3. That the greater the degree of injury, the slower the rate of regeneration, and the greater the duration of the moulting cycle.

These experiments, therefore, indicate that there is an interaction between the two processes of regeneration and moulting, of such a nature that the introduction of one will disturb the normal activity of the other. Since, also, this interaction varies at different times in the moulting cycle, it emphasizes the importance of taking this factor into account when drawing conclusions from experiments made upon crustacea and other animals which undergo ecdysis.

C. JUDSON HERRICK,
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SCIENTIFIC BOOKS

L'Attention. By. W. B. PILLSBURY. Paris: Doin, 1906. 8vo. Pp. 304. Bibliothèque Internationale de Psychologie Experimentale.

A sufficient number of the fifty volumes that are to form this series of handbooks of experimental psychology have appeared to justify the plan of the whole and to demonstrate their serviceability. Professor Pillsbury's volume on the attention is well conceived and well executed; it is so particularly from the point of view of the student, and thus will be a welcome addition to the pedagogical literature when available in English.